Experiments to Control the Alfalfa Weevil with Hydraulic Spray and Granular Applications

BULLETIN 578T—MAY 1969

West Virginia University

The Authors

C. K. Dorsey is Entomologist; L. P. Stevens is Assistant Horticulturist in Charge of the Reedsville Experiment Farm; and J. E. Weaver is Research Assistant in Entomology.

Acknowledgment

The assistance of Dr. J. A. Jung, Agronomist, in procuring hay yield data is gratefully acknowledged.

West Virginia University
Agricultural Experiment Station
College of Agriculture and Forestry
A. H. VanLandingham, Director
Morgantown

Experiments to Control the Alfalfa Weevil with Hydraulic Spray and Granular Applications

C. K. DORSEY, L. P. STEVENS and J. E. WEAVER

An integrated program affecting the various life stages of the alfalfa weevil is a realistic control approach. Such a program was the main objective of the experimental studies reported on in this bulletin.

In an effort to determine more effective ways to control the alfalfa weevil *Hypera postica* De Geer, a series of experiments was started in 1965 and completed in 1967. The experimental plots were located in the northern and eastern areas of West Virginia.

Hydraulic sprays were applied either as foliar or stubble treatments directed mainly against larval and adult stages of the weevil. The granular formulations of insecticides were applied during the dormant or semi-dormant alfalfa season and were also directed principally against larval and adult stages.

Methods and Materials

In 1965, 41 different kinds of treatments were applied on replicated (2X) plots varying in size from ¼ to 2 acres for a total of 17 acres.

Forty-nine acres were treated experimentally in 1966. There were 19 different treatments made on replicated (2X) plots which varied in size from 1/64 acre to 10 acres.

The experiments in 1967 involved 146 acres and included 100 different treatments applied on replicated (2X) plots varying in size from 1/16 acre to 10 acres.

The spray formulations were applied in low gallonage (15-30 Gal/A), and low medium pressure (30-90 psi) with hydraulic ground equipment. Granular formulations were applied with hand-operated, rotary-type spreaders.

A total of 36 different kinds of insecticidal chemicals were used in these experiments (1965-67) and they are listed in Tables 1-7. The insecticides included in these tests not having common names were: NIA-10242, 2,3-dihydro-2,2-dimethyl-7-benzofuranyl methylcarbamate (Fura-

dan®); GS-13005, S-(2-methoxy-5-oxo-Δ^2-1, 3,4-thiadiazolin-4-YL) methyl) 0,0-dimethyl phosphorodithioate; Stauffer N-4543, 0-isopropyl S-(Phthal imidomethyl) ethyl-phosphonodithioate; Galecron, N-(2-methyl-4-chlorophenyl) N′, N′ dimethyl formamidine; Amer. Cyan. 47031, (cyclic ethylene (diethoxyphosphinyl) dithioimidocarbonate; Amer. Cyan. 47470, P,P-diethyl cyclic propylene ester of phosphonodithio=imidocarbonic acid; SD-9129, dimethyl phosphate ester with *cis* 3-hydroxy-N-methylcrotonamide; SD-7438, S,S′-benzylidene bis-(0,0-dimethyl phosphorodithioate) and SD-8447, 2-chloro-1-(2,4,5-tri=chlorophenyl) vinyl dimethyl phosphate.

Population sampling was accomplished with a 15-inch diameter sweeping net using 180° sweeps; 25 per replicate were taken in the median area of each plot. The sweepings were bagged and taken to the laboratory for processing.

Results and Discussion

Treatments are considered economically effective when they reduce weevil populations approximately 80 per cent.

None of the hydrocarbon sprays applied in April, 1965 as foliar treatments was effective against the adult weevils because there were very few adult weevils moving around above ground at that time (Table 1-A). Sun Oil 91EL (a naphthenic oil) at two and four Gallons Per Acre (G/A) and 11 EL (a paraffinic oil) at 4 G/A in combination with malathion (0.5 lb/A) applied as sprays produced economic control of weevil larvae. In another series of experiments on the same farm (Reedsville), at least five different hydrocarbon and hydrocarbon-insecticide combination sprays were highly effective against adult weevils (Table 1-B). The weather was warm at the time of application and it is believed that the hibernating weevils were either beginning to emerge or were near the soil surface. Sun Oil 11E (a paraffinic oil) gave the best results of all the sprays. The Baygon granular treatment was equally as effective. All of the treatments gave good to fair control of the larvae, but not economic control (Table 1-B).

When the experimental treatments were applied on the Widmyer Farm (Table 2-A) in mid-March the weather was warmer than usual and it is believed that in this case, also, the hibernating adults were either beginning to emerge or were moving closer to the soil surface. Bennett and Thomas (1963) observed that newly emerged adult weevils were much easier to kill than after a brief period of maturity. At least seven different treatments gave economic or near-economic control of the adults for about six weeks post-treatment. None of the treatments gave economic

TABLE 1

COMPARATIVE EFFECTIVENESS OF HYDROCARBONS AND INSECTICIDE-HYDROCARBON MIXTURES APPLIED HYDRAULICALLY AS FOLIAR SPRAYS FOR ALFALFA WEEVIL CONTROL (1965).

Adult Weevils			Weevil Larvae		
Treatments[a]	Comp. Effectiveness[b]	% Kill	Treatments[a]	Comp. Effectiveness[b]	% Kill
A-REEDSVILLE FARM (Plots 0.25A x 2) (Coll. 5-11-65)					
14	a	0.0	5	a	88.0
6	a	0.0[c]	4	ab	84.0
4	a	0.0[c]	12	abc	82.0
1	a	0.0[c]	6	abc	78.0
7	a	0.0[c]	1	abc	74.0
5	a	0.0[c]	3	abc	71.0
10	a	0.0[c]	13	abcd	66.0
8	a	0.0[c]	8	abcd	66.0
13	a	0.0[c]	7	abcd	64.0
2	a	0.0[c]	2	abcd	64.0
3	a	0.0[c]	11	bcd	61.0
9	a	0.0[c]	10	cd	47.0
11	a	0.0[c]	9	cd	47.0
12	a	0.0[c]	14	d	0.0**
(Coll. 5-19-65)					
6	a	63.0	8	a	71.0
5	ab	50.0	6	a	71.0
11	abc	25.0	3	a	68.0
1	abc	0.0[c]	11	a	64.0
9	abc	0.0[c]	10	ab	55.0
14	abc	0.0	5	ab	49.0
13	abc	0.0[c]	2	ab	49.0
8	abc	0.0[c]	13	ab	48.0
10	abc	0.0[c]	4	ab	42.0
7	abc	0.0[c]	7	ab	42.0
4	abc	0.0[c]	1	ab	36.0
12	bc	0.0[c]	9	ab	36.0
3	c	0.0[c]	12	ab	27.0
2	c	0.0[c]**	14	b	0.0**

[a]Table 1-A Treatments: (Hydraulic sprayer, 30 psi, 15 G/A; applied 4-13-65)

1. 7E (Sun Oil), 2 G/A
2. 7EL (Sun Oil), 2 G/A
3. 7EL, 8 G/A
4. 91EL (Sun Oil), 2 G/A
5. 91EL, 4 G/A
6. 91EL, 8 G/A
7. 11EL (Sun Oil), 2 G/A
8. 11EL, 4 G/A
9. 11EL, 8 G/A
10. Malathion, EC (0.5 lb/A) + 7EL (4 G/A)
11. Malathion, EC (0.5) + 91EL (4 G)
12. Malathion, EC (0.5) + 11EL (4 G)
13. Malathion, EC (0.5) + dimethylsulfoxide, 1.0%
14. Untreated (Geometric average adult weevil count 5.0; larval count 1517.0)

(Continued)

TABLE 1 (Continued)

Adult Weevils			Weevil Larvae		
Treat-ments[a]	Comp. Effective-ness[b]	% Kill	Treat-ments[a]	Comp. Effective-ness[b]	% Kill
B-REEDSVILLE FARM (Plots 0.12A x 2) (Coll. 5-6-65)					
1	a	92.0	3	a	78.0
11	a	92.0	10	a	78.0
7	a	92.0	9	b	77.0
3	a	92.0	4	b	75.0
10	ab	83.0	1	b	74.0
6	ab	79.0	11	bc	71.0
5	ab	79.0	5	bc	71.0
9	ab	67.0	7	bc	71.0
4	ab	67.0	6	c	65.0
2	ab	50.0	2	c	63.0
8	b	0.0**	8	d	0.0**

[a]Table 1-B Treatments: (Hydraulic sprayer, 15 G/A; applied 3-17-65)

1. 11EL (Sun Oil) 4 G/A
2. Diazinon, EC (0.75) + 11E (4 G)
3. Baygon, Gr. (1.0)
4. Malathion, (0.75) + 7E (4 G)
5. Malathion, EC (0.75) + 11E (2 G) + DMSO 1.0%
6. Diazinon, EC (0.75) + 9E (2 G)
7. 11E (2 G) + DMSO 1.0%
8. Untreated (Geometric average adult weevil count 12.0; larval count 3407.0)
9. Malathion, EC (0.75) + 11E (4 G)
10. 9E (2 G) + DMSO 1.0%
11. 11E (4 G) + DMSO 1.0%

[b]Duncan's Multiple Range Test at level indicated for Log (N + 1) of the data; antilog of data means —1 is presented as the geometric average count for 25 sweeps. Treatments sharing a letter in common do not differ in effectiveness.

[c]The aberrant data concerning adult weevil counts is mainly because of the scarcity of weevils at this time of the season. Negative control (more specimens in treated than in untreated plots) is acknowledged by 0.0% to indicate lack of control.

**5.0 per cent level of significance.

larval control, but five produced near-economic results. The same treatments were applied in an adjacent part of the field about three weeks later. Only one treatment, phorate granules, reduced adult populations five weeks post-treatment to an economic level (Table 2-B). Two treatments, phorate granules (2.0 lb/A) and malathion (1.0 lb/A) plus Sun Cote (2 G/A) wax spray, gave economic control of the larvae and GS-13005 (1.0 lb/A) spray gave near-economic control. Wilson (1966) reported fair control from phorate granules applied in mid-March. The malathion spray mixed with the water-miscible Sun Cote wax was applied to try to determine if the residual effectiveness of malathion could be extended. In another similar application the malathion spray was permitted to dry on the alfalfa foliage and then the Sun Cote wax spray (2 G/A) was applied. The application of Sun Cote wax apparently pro-

TABLE 2

COMPARATIVE EFFECTIVENESS OF VARIOUS INSECTICIDES APPLIED WITH HYDRAULIC SPRAYERS AS FOLIAR AND GRANULES AS GROUND TREATMENTS TO CONTROL THE ALFALFA WEEVIL (1965).

Adult Weevils			Weevil Larvae		
Treatments[a]	Comp. Effectiveness[b]	% Kill	Treatments[a]	Comp. Effectiveness[b]	% Kill
		WIDMYER FARM A –Site 1 (Coll. 5-6-65)			
1	a	92.0	3	a	78.0
11	a	92.0	10	a	78.0
7	ab	88.0	9	ab	77.0
3	ab	88.0	4	ab	75.0
10	ab	83.0	1	ab	74.0
6	ab	79.0	11	ab	71.0
5	ab	79.0	5	ab	71.0
9	ab	67.0	7	abc	65.0
4	ab	67.0	6	bc	63.0
2	ab	50.0	2	c	54.0
8	b	0.0	8	d	0.0**

[a]Table 2-A Treatments: (Hydraulic sprayer, 30 psi, 15G/A; applied 3-17-65)

1. Phorate, Gr. (2.0)
2. NIA-10242, Gr. (1.0)
3. Malathion, EC (1.0) + Sun Cote Wax (2 G)
4. GS-13005, EC (1.0)
5. Phorate, Gr. (1.0)
6. SD-7438, EC (1.0)
7. SD-7438, EC (1.5)
8. Untreated (Geometric average adult weevil count 12.0; larval count 3407.0)
9. Malathion, EC (1.0)
10. Malathion, EC (1.0) followed by Sun Cote Wax (2 G)
11. SD-9129, EC (1.0)

(Continued)

longed the effectiveness of malathion in this particular field test when compared with the results obtained from plots treated only with malathion, but not to a significant level (Table 2-A and B).

Alfalfa stubble (first cutting) on the Blue Farm was treated (in three fields, 30 A) with Alfatox and parathion sprays three days after hay removal. All treatments were economically effective against the adults and larvae for two weeks post-treatment (Table 3). Parathion was effective for three weeks post-treatment against larvae during this rather dry period of the summer. Pfadt (1964) also reported that parathion spray was a very satisfactory stubble treatment.

In 1966 certain hydrocarbon and hydrocarbon-insecticide combination sprays were again applied experimentally on the Blue Farm. The applications were carefully timed by field inspections in an attempt to

TABLE 2 (Continued)

Adult Weevils			Weevil Larvae		
Treat-ments[a]	Comp. Effective-ness[b]	% Kill	Treat-ments[a]	Comp. Effective-ness[b]	% Kill
		B —Site 2 (Coll. 5-13-65)			
1	a	92.0	2	a	83.0
7	ab	75.0	3	ab	82.0
2	ab	60.0	5	abc	76.0
10	ab	42.0	4	abc	74.0
9	ab	33.0	10	abc	71.0
3	ab	3.0	7	abc	62.0
5	ab	0.0	9	abc	62.0
11	ab	0.0	1	bcd	57.0
8	ab	0.0	8	bcd	57.0
6	b	0.0	6	cd	48.0
4	b	0.0	11	d	0.0**

[a]Table 2-B Treatments: (Hydraulic sprayer, 30 psi, 15G/A; applied 4-7-65)

1. Phorate, Gr. (2.0)
2. NIA-10242, Gr. (1.0)
3. Malathion, EC (1.0) + Sun Cote Wax (2 G)
4. GS-13005, EC (1.0)
5. Phorate, Gr. (1.0)
6. SD-7438, EC (1.0)
7. SD-7438, EC (1.5)
8. Untreated (Geometric average adult weevil count 14.0; larval count 1469.0)
9. Malathion, EC (1.0)
10. Malathion, EC (1.0) followed by Sun Cote Wax (2 G)
11. SD-9129, EC (1.0)

[b]Duncan's Multiple Range Test at level indicated for Log (N + 1) of the data; antilog of data means —1 is presented as the geometric average count for 25 sweeps. Treatments sharing a letter in common do not differ in effectiveness.

**5.0 per cent level of significance.

contact optimal numbers of adult weevils at peak periods of egg-laying, both in the fall and in the spring. The results presented in Table 4-A show that methyl parathion spray applied in the spring, 91EL spray applied in either fall or spring, and 91EL spray mixed with malathion applied in the fall are all effective against adult weevils. The fall application of 91EL and the spring applications of 91EL and methyl parathion sprays were highly effective in reducing larval populations. All of the plots included in this particular experiment except the one which received the 91EL plus malathion spray in the fall and in the spring were additionally treated as indicated in Table 4-B. Greater adult weevil reductions were evident in plots receiving additional spray treatments in May. The fall and spring spray treatments with 91EL plus malathion continued to give excellent to good economic control until harvest (May 25).

A 20-acre field on the Hockensmith Farm was sprayed with parathion. Weekly sampling for three weeks indicated that economic control was not accomplished against adults or larvae (Table 4-C).

TABLE 3

COMPARATIVE EFFECTIVENESS OF ALFALFA WEEVIL CONTROL USING INSECTICIDES APPLIED ON THE STUBBLE (FIRST CUTTING) WITH HYDRAULIC SPRAYERS (1965).

ADULT WEEVILS			WEEVIL LARVAE		
TREAT-MENTS[a]	COMP. EFFECTIVE-NESS[b]	% KILL	TREAT-MENTS[a]	COMP. EFFECTIVE-NESS[b]	% KILL
BLUE FARM (Fields 2, 7 and 10) (Plots 2A x 2) (Coll. 6-9-65)					
2	a	94.0	2	a	100.0
4	a	82.0	1	a	100.0
3	a	82.0	3	a	93.0
1	b	76.0	4	a	93.0
5	c	0.0**	5	b	0.0**
(Coll. 6-16-65)					
4	a	89.0	4	a	98.0
2	a	89.0	2	a	96.0
3	ab	78.0	1	ab	81.0
1	ab	77.0	3	ab	75.0
5	b	0.0**	5	b	0.0**
(Coll. 6-23-65)					
2	a	80.0	4	a	100.0
1	a	60.0	2	b	68.0
3	a	20.0	3	b	56.0
5	a	0.0	1	b	8.0
4	a	0.0[c]**	5	b	0.0*

[a]Treatments: (Hydraulic sprayer, 30 psi, 15 G/A; applied 6-1-65)
1. Parathion, EC (0.3)
2. Alfatox, (2 qts.)
3. Parathion, EC (0.3)
4. Parathion, EC (0.3)
5. Untreated (Geometric average of adult weevil count 12.0; larval count 19.0)

[b]Duncan's Multiple Range Test at level indicated for Log (N + 1) of the data; antilog of data means —1 is presented as the geometric average count for 25 sweeps. Treatments sharing a letter in common do not differ in effectiveness.

[c]The aberrant data concerning adult weevil counts is mainly because of the scarcity of weevils at this time of the season. Negative control (more specimens in treated than in untreated plots) is acknowledged by 0.0% to indicate lack of control.

*1.0 per cent level of significance.

**5.0 per cent level of significance.

A five-acre field on the Reedsville Farm was sprayed with malathion late in May when adult weevils were fairly numerous. Excellent adult weevil reductions were evident for two weeks post-treatment, and larval reductions for one week post-treatment (Table 4-D). Larval control failed

TABLE 4

COMPARATIVE EFFECTIVENESS OF ALFALFA WEEVIL CONTROL WITH HYDRAULIC SPRAY FOLIAR APPLICATIONS (1966).

Adult Weevils			Weevil Larvae		
Treatments[a]	Comp. Effectiveness[b]	% Kill	Treatments[a]	Comp. Effectiveness[b]	% Kill
A—BLUE FARM (Field 2) (Plots 2A x 2) (Coll. 5-1-66)					
4	a	100.0	4	a	70.0
2	a	100.0	4	a	67.0
1	b	50.0	1	ab	45.0
6	bc	0.0	2	ab	41.0
5	bc	0.0[c]	3	ab	33.0
3	c	0.0[c]**	6	b	0.0**
(Coll. 5-10-66)					
4	a	100.0	3	a	97.0
3	a	100.0	4	b	96.0
2	a	100.0	2	bc	92.0
1	a	100.0	5	bcd	65.0
6	b	0.0	1	cd	53.0
5	b	0.0[c]*	6	d	0.0**

[a]Table 4-A Treatments: (Hydraulic sprayer, 30 psi, 20 G/A; applied as indicated)
1. 91EL (Sun Oil) 4 G/A + malathion, LV (0.75), 10-30-65
2. 91EL (4 G/A), 10-30-65
3. 91EL (4 G/A), 4-20-66
4. Methyl parathion, EC (0.5), 4-20-66
5. 91EL (4 G/A) + malathion, LV (0.75), 4-20-66
6. Untreated (Geometric adult weevil count 1.0; larval count 647.0)

Adult Weevils			Weevil Larvae		
Treatments	Comp. Effectiveness	% Kill	Treatments	Comp. Effectiveness	% Kill
B—BLUE FARM (Field 2) (Plots 2A x 2) (Coll. 5-19-66)					
5	a	100.0	5	a	97.0
2	a	100.0	1	b	95.0
3	ab	76.0	4	b	84.0
1	ab	76.0	2	bc	81.0
4	ab	52.0	3	bc	80.0
6	b	0.0**	6	c	0.0***
(Coll. 5-25-66)					
5	a	100.0	2	a	96.0
3	ab	85.0	5	a	96.0
2	ab	85.0	1	a	93.0
1	ab	42.0	4	a	87.0
6	ab	0.0	3	b	33.0
4	b	0.0[c]***	6	b	0.0**

[a]Table 4-B Treatments: (Hydraulic sprayer, 30 psi, 20 G/A; applied as indicated)
1. 91EL (Sun Oil) 4 G/A, 10-30-65 and 5-4-66; SD-7438, EC (0.25) + methyl parathion, EC (0.25), 5-11-66
2. 91EL (4 G) + malathion, LV (0.75), 10-30-65
3. Methyl parathion, EC (0.5), 4-20 and 5-4-66
4. 91EL (4 G) + malathion, LV (0.75), 4-20-66
5. 91EL (4 G), 4-20 and 5-4-66; SD-7438, EC (0.25) + methyl parathion, EC (0.25), 5-11-66
6. Untreated (Geometric average adult weevil count 5.0; larval count 1719.0)

C—HOCKENSMITH FARM (Plots 10A x 2)

(Coll. 5-10-66)					
2	a	0.0	1	a	46.0
1	a	0.0[c]	2	a	0.0
(Coll. 5-19-66)					
2	a	0.0	1	a	53.0
1	a	0.0[c]	2	b	0.0
(Coll. 5-25-66)					
2	a	0.0	1	a	25.0
1	a	0.0[c]	2	a	0.0

[a]Table 4-C Treatments: (Hydraulic sprayer, 90 psi, 30 G/A; applied 5-3-66)
1. Parathion, EC (0.5)
2. Untreated (Geometric average adult weevil count 7.0; larval count 1280.0)

D—REEDSVILLE FARM (A3, S2) (Plots 2.5A x 2)

(Coll. 6-10-66)					
1	a	100.0	1	a	95.0
2	b	0.0*	2	b	0.0*
(Coll. 6-17-66)					
1	a	100.0	2	a	0.0
2	b	0.0	1	a	0.0[c]

[a]Table 4-D Treatments: (Hydraulic sprayer, 40 psi, 26 G/A; applied 5-27-66)
1. Malathion, EC (1.0)
2. Untreated (Geometric average adult weevil count 32.0; larval count 403.0)

(Continued)

the second week post-treatment and this cannot be explained. Malathion sprays properly applied under optimum conditions normally give at least two weeks protection against weevil larvae in this area.

Total hay yield and total alfalfa yield data were collected from plots on the Blue Farm in 1966. The results of these collections are presented in Table 5. All treated plots produced more hay and more alfalfa hay than the untreated plots. The plots which received two properly timed foliar sprays in the spring produced the most hay.

In 1967, four different kinds of insecticides were used experimentally on the Demory Farm for alfalfa weevil control. All treatments gave economic or near-economic adult weevil population reductions for one week

TABLE 4 (Continued)

Adult Weevils			Weevil Larvae		
Treat-ments[a]	Comp. Effective-ness[b]	% Kill	Treat-ments[a]	Comp. Effective-ness[b]	% Kill
E—Widmyer Farm (Field 7) (Plots 1A x 2) (Coll. 5-10-66)					
3	a	100.0	3	a	72.0
1	ab	100.0	1	a	69.0
2	ab	60.0	2	a	43.0
4	b	0.0***	4	a	0.0
(Coll. 5-19-66)					
4	a	0.0	3	a	45.0
1	a	0.0[c]	2	ab	14.0
2	a	0.0[c]	4	ab	0.0
3	a	0.0[c]	1	b	0.0[c]***

[a]Table 4-E Treatments: (Hydraulic sprayer, 30 psi, 15 G/A; applied 5-5-66)
1. 91EL (Sun Oil) 4 G/A; mixture sat over night in sprayer, was heavy-bodied when applied
2. 91EL (4 G), fresh mix
3. 91EL (4 G) + malathion, EC (1.0)
4. Untreated (Geometric average adult weevil count 1.0; larval count 634.0)

F—(Plots 1/64 A x 2) (Coll. 5-10-66)					
4	a	100.0	3	a	88.0
3	a	100.0	4	a	83.0
1	a	100.0	2	a	81.0
5	a	0.0	5	b	0.0
2	a	0.0[c]	1	b	0.0[c]*
(Coll. 5-19-66)					
5	a	0.0	3	a	87.0
2	a	0.0[c]	2	a	81.0
3	a	0.0[c]	4	b	76.0
1	a	0.0[c]	5	b	0.0
4	a	0.0[c]	1	b	0.0[c]*

[a]Table 4-F Treatments: (Hydraulic knapsack sprayer, 20 psi, 15 G/A; applied 5-3-66)
1. Nicotine sulfate, EC (1.0)
2. SD-14999, EC (0.25)
3. SD-14999, EC (1.0)
4. SD-14999, EC (0.5)
5. Untreated (Geometric average adult weevil count 1.0; larval count 604.0)

[b]Duncan's Multiple Range Test at level indicated for Log (N + 1) of the data; antilog of data means −1 is presented as the geometric average count for 25 sweeps. Treatments sharing a letter in common do not differ in effectiveness.

[c]The aberrant data concerning adult weevil counts is mainly because of the scarcity of weevils at this time of the season. Negative control (more specimens in treated than in untreated plots) is acknowledged by 0.0% to indicate lack of control.

*1.0 per cent level of significance.

**5.0 per cent level of significance.

***10.0 per cent level of significance.

TABLE 5

HAY YIELD DATA FROM FIELDS TREATED WITH HYDRAULIC SPRAY APPLICATIONS (1966).

TREATMENTS (SPRAY APP. AS INDICATED)	TOTAL HAY AVERAGE YIELD[a] TONS/A	TOTAL ALFALFA AVERAGE YIELD[a] TONS/A
BLUE FARM, Field 2 (Plots 1.5A x 2)		
Sprayed October 30, 1965 and May 4, 1966, 91EL, Sun Oil (4G)	0.88	0.88
Sprayed April 20, 1966 and May 4, 1966, 91EL (4G)	0.96	0.96
Sprayed April 20, 1966 and May 4, 1966, Methyl Parathion, EC (0.5)	1.13	1.13
Sprayed October 20, 1965, 91EL (4G) + Malathion, LV (0.75)	0.90	0.90
Sprayed April 20, 1966, 91EL (4G) + Malathion, LV (0.75)	0.92	0.92
Sprayed April 20 and May 4, 1966, SD-7438, EC (0.5)	1.35	1.35
Field 3 (Plots 1A x 2)		
Malathion, EC (1.0) May 4, 1966	1.44	1.00
Untreated	0.69	0.69

[a]Average of 4 samples, 2 feet wide and 20 feet long.

post-treatment; methyl parathion gave the best reduction. All treatments produced economic larval control one week post-treatment with NIA-10242 WP sprays giving the best control. NIA-10242 WP and methyl parathion EC remained highly effective two weeks post-treatment (Table 6-A).

Imidan sprays were applied experimentally on plots on the Butler Farm, April 26. All treatments (EC and WP formulations) produced excellent adult weevil control except Imidan EC at 0.5 lb/acre. All treatments except Imidan, EC (0.5) gave economic control of the larvae (one week post-treatment and three treatments, WP (1.0), EC (0.5), and WP (0.5), gave economic control two weeks post-treatment (Table 6-B). Dorsey (1966) observed that Imidan was a promising material in his work during 1963-64.

The plots were treated again with Imidan sprays on May 13 and when sampled one week later all treatments produced perfect adult weevil control. Both the wettable powder and emulsifiable formulation at 0.5 and 1.0 lb/A rates gave economic larval control five days post-treatment (Table 6-C).

TABLE 6

Comparative Effectiveness of Various Insecticides Applied With Hydraulic Sprayers as Foliar Treatments to Control the Alfalfa Weevil (1967).

Adult Weevils			Weevil Larvae		
Treat-ments[a]	Comp. Effective-ness[b]	% Kill	Treat-ments[a]	Comp. Effective-ness[b]	% Kill
		A—DEMORY FARM (Plots 2A x 2)			
		(Coll. 5-24-67)			
5	a	95.0	3	a	98.0
4	ab	82.0	2	a	97.0
1	ab	82.0	5	a	96.0
2	ab	78.0	4	a	91.0
3	ab	70.0	1	ab	85.0
6	b	0.0**	6	b	0.0**
		(Coll. 5-31-67)			
3	a	59.0	3	a	97.0
2	ab	41.0	2	a	94.0
6	bc	0.0	5	ab	92.0
1	c	0.0[c]	4	bc	77.0
5	c	0.0[c]	1	cd	68.0
4	c	0.0[c]**	6	d	0.0**

[a]Table 6-A Treatments: (Hydraulic sprayer, 40 psi, 25 G/A; applied 5-17 and part 5-18-67)

1. Stauffer N14543, EC (1.0), 5-17-67 (Rain)
2. NIA-10242, 50WP (1.0), 5-17-67 (Rain)
3. NIA-10242, 50 WP (1.0), 5-18-67
4. SD-8447, 75WP (1.0), 5-18-67
5. Methyl parathion, EC (0.5), 5-18-67
6. Untreated: (Geometric average adult weevil count 7.0; larval count 286.0)

		B—BUTLER FARM (Plots 1.25A x 2) No. 1 Program			
		(Coll. 5-7-67)			
6	a	0.0[c]	2	a	93.0
5	a	0.0[c]	4	ab	88.0
4	a	0.0[c]	1	ab	85.0
3	a	0.0[c]	6	b	78.0
2	a	0.0[c]	5	b	75.0
1	a	0.0[c]	3	b	73.0
7	a	0.0	7	c	0.0**
		(Coll. 5-10-67)			
6	a	100.0	2	a	89.0
4	a	100.0	5	a	86.0
3	a	100.0	4	a	82.0
2	a	100.0	1	ab	73.0
1	a	100.0	3	ab	66.0
7	a	0.0	6	b	9.0
5	a	0.0[c]	7	b	0.0**

"Table 6-B Treatments: (Hydraulic sprayer, 40 psi, 25 G/A; applied 4-26-67)
1. Imidan, 3E (1.0)
2. Imidan, 50WP (1.0)
3. Imidan, 3E (0.5) (Old Stock)
4. Imidan, 50WP (0.5)
5. Imidan, 3E (0.5)
6. Imidan, 3E (1.0) (Old Stock)
7. Untreated (Geometric average adult weevil count 1.0; larval count 52.0)

C–BUTLER FARM (Plots 1.25A x 2) No. 2 Program
(Coll. 5-18-67)

6	a	100.0	2	a	90.0
4	ab	100.0	4	ab	86.0
3	ab	100.0	5	abc	82.0
2	ab	100.0	1	abc	78.0
1	ab	100.0	3	bc	69.0
5	ab	100.0	6	cd	55.0
7	b	0.0***	7	d	0.0*

"Table 6-C Treatments: (Hydraulic sprayer, 40 psi, 25 G/A; treated 4-26 and 5-13-67) Same as in BUTLER FARM No. 1 Program, repeated on 5-13-67 Untreated (Geometric average adult weevil count 1.0; larvae count 51.0)

D–BLUE FARM (Field 5) (Plots 1.25A x 2)

		(Coll. 5-10-67)			
3	a	100.0	1	a	95.0
1	a	100.0	3	b	50.0
2	a	0.0	2	b	0.0**
		(Coll. 5-16-67)			
3	a	100.0	3	a	100.0
1	a	100.0	2	b	0.0
2	a	0.0	1	b	0.0c**
		(Coll. 5-24-67)			
2	a	0.0	1	a	39.0
1	a	0.0c	3	a	19.0
3	a	0.0c	2	a	0.0

"Table 6-D Treatments: (Hydraulic sprayer, 90 psi, 20 G/A; applied 5-5-67) These plots were sprayed with malathion, EC (1.0), 4-20-67)
1. Malathion, EC (0.75)
2. Untreated (Geometric average adult weevil count 3.0; larval count 20.0)
3. Methyl parathion, EC (0.25)

(Continued)

Field 5 on the Blue Farm was treated with malathion and methyl parathion sprays. Both materials produced excellent adult weevil reductions one and two weeks post-treatment; malathion gave excellent larval control one week post-treatment while methyl parathion gave satisfactory larval control two weeks post-treatment (Table 6-D). Harrendorf, *et al.*,

TABLE 6 (Continued)

Adult Weevils			Weevil Larvae		
Treat-ments[a]	Comp. Effective-ness[b]	% Kill	Treat-ments[a]	Comp. Effective-ness[b]	% Kill
E—WIDMYER FARM (Field 9) (Plots 10A x 2)					
(Coll. 4-27-67)					
1	a	0.0[c]	1	a	88.0
2	a	0.0	2	b	0.0
(Coll. 5-3-67)					
2	a	0.0[c]	1	a	78.0
1	a	0.0	2	b	0.0
(Coll. 5-11-67)					
1	a	100.0	1	a	95.0
2	a	0.0	2	b	0.0

[a]Table 6-E Treatments: (Hydraulic sprayer, 30 psi, 15 G/A; applied 4-21-67)
1. Parathion, EC (0.5)
2. Untreated (Geometric average adult weevil count 1.0; larval count 37.0)

Adult Weevils			Weevil Larvae		
Treat-ments[a]	Comp. Effective-ness[b]	% Kill	Treat-ments[a]	Comp. Effective-ness[b]	% Kill
F—WIDMYER FARM (Field 7) (Plots 9A x 2)					
(Coll. 4-27-67)					
2	a	0.0	1	a	78.0
1	a	0.0[c]	2	a	0.0
(Coll. 5-3-67)					
1	a	100.0	1	a	87.0
2	a	0.0	2	a	0.0
(Coll. 5-10-67)					
1	a	100.0	1	a	44.0
2	a	0.0	2	a	0.0
(Coll. 5-16-67)					
1	a	85.0	2	a	0.0
2	a	0.0	1	a	0.0[c]
(Coll. 5-31-67)					
1	a	100.0	1	a	38.0
2	b	0.0	2	a	0.0

[a]Table 6-F Treatments: (Hydraulic sprayer, 30 psi, 15 G/A; applied 4-20-67)
1. Malathion, EC (1.0)
2. Untreated (Geometric average adult weevil count 3.0; larval count 65.0)

G—WIDMYER FARM (Field 7) (Plots 4.5A x 2)
(Coll. 5-31-67)

2	a	100.0	1	a	82.0
1	a	100.0	2	a	72.0
3	b	0.0*	3	b	0.0**

[a]Table 6-G Treatments: (Hydraulic sprayer, 30 psi, 15 G/A; 1st treatment applied 4-6-67; 2nd treatment applied 4-20-67; 3rd treatment 5-26-67)

1. Malathion, EC (1.0), 3 foliar applications
2. Malathion, EC (1.0), 2 foliar applications
3. Untreated (Geometric average adult weevil count 2.0; larval count 307.0)

H—REEDSVILLE FARM (A7, S4) (Plots 2A x 2)
(Coll. 5-12-67)

2	a	100.0	2	a	100.0
1	b	0.0***	1	b	0.0*
		(Coll. 5-19-67)			
2	a	94.0	2	a	100.0
1	b	0.0	1	b	0.0*
		(Coll. 5-25-67)			
2	a	60.0	2	a	97.0
1	a	0.0	1	b	0.0**

[a]Table 6-H Treatments: (Hydraulic sprayer, 30 psi, 15 G/A; applied 5-2-67)

1. Untreated (Geometric average adult weevil count 4.0; larval count 1004.0)
2. Methyl parathion, EC (1.0)

I—BLUE-HOCKENSMITH FARM (Plots 5A x 2)
(Coll. 5-10-67)

3	a	0.0[c]	1	a	92.0
2	a	0.0[c]	2	b	88.0
1	a	0.0	3	c	0.0*
		(Coll. 5-16-67)			
2	a	0.0[c]	1	a	90.0
1	a	0.0[c]	2	a	89.0
3	a	0.0	3	b	0.0***

[a]Table 6-I Treatments: (Hydraulic sprayer, 90 psi, 20 G/A; applied 4-26-67)

1. Azinphosmethyl, EC (1.5 lb/gallon) (0.75)
2. Azinphosmethyl, EC (1.5 lb/gallon) (0.5)
3. Untreated (Geometric average adult weevil count 1.0; larval count 51.0)

(Continued)

TABLE 6 (Continued)

Adult Weevils			Weevil Larvae		
Treatments[a]	Comp. Effectiveness[b]	% Kill	Treatments[a]	Comp. Effectiveness[b]	% Kill
		J—BLUE FARM (Plots 5A x 2)			
		(Coll. 4-28-67)			
			1	a	97.0
			6	ab	93.0
			2	ab	93.0
			3	ab	90.0
			4	ab	81.0
			5	b	0.0**
		(Coll. 5-3-67)			
6	a	100.0	3	a	77.0
4	a	100.0	6	ab	43.0
3	a	100.0	2	ab	43.0
2	a	100.0	4	ab	35.0
1	a	0.0	1	ab	25.0
5	a	0.0	5	b	0.0**
		(Coll. 5-10-67)			
6	a	100.0	2	a	96.0
3	ab	100.0	3	a	86.0
2	ab	100.0	6	b	50.0
5	ab	0.0	1	b	45.0
1	ab	0.0[c]	4	b	5.0
4	b	0.0[c]****	5	b	0.0**
		(Coll. 5-16-67)			
6	a	100.0	6	a	100.0
2	a	100.0	5	b	0.0
1	ab	81.0	2	b	0.0[c]
3	ab	81.0	3	b	0.0[c]
4	bc	61.0	1	bc	0.0[c]
5	c	0.0**	4	c	0.0[c]***
		(Coll. 5-24-67)			
3	a	63.0	2	a	78.0
2	ab	26.0	3	ab	75.0
4	ab	5.0	6	ab	51.0
5	ab	0.0	5	abc	0.0
6	ab	0.0[c]	4	bc	0.0[c]
1	b	0.0[c]	1	c	0.0[c]

[a]Table 6-J Treatments: (Hydraulic sprayer, 90 psi, 20 G/A; applied 4-20-67)
1. Carbaryl, 80WP, (2.0)
2. Malathion, EC (1.0)
3. Methyl parathion, EC (0.25)
4. Parathion, EC (0.25)
5. Untreated (Geometric average adult weevil count 3.0; larval count 93.0)
6. Methyl parathion, EC (0.5)

K—REEDSVILLE FARM (A8, S3) (Plots 3.5A x 2)					
(Coll. 5-5-67)					
1	a	23.0	1	a	45.0
2	a	0.0	2	b	0.0***
(Coll. 5-12-67)					
2	a	0.0	1	a	63.0
1	a	0.0[c]	2	b	0.0***
(Coll. 5-25-67)					
1	a	85.0	1	a	95.0*
2	a	0.0	2	b	0.0*

[a]Table 6-K Treatments: (Hydraulic sprayer, 30 psi, 15 G/A)

1. Carbaryl, 80WP (1.5) applied 4-26-67; sprayed with malathion, EC (1.0), 5-18-67
2. Untreated (Geometric average adult weevil count 40.0; larval count 865.0)

[b]Duncan's Multiple Range Test at level indicated for Log (N + 1) of the data; antilog of data means —1 is presented as the geometric average count for 25 sweeps. Treatments sharing a letter in common do not differ in effectiveness.

[c]The aberrant data concerning adult weevil counts is mainly because of the scarcity of weevils at this time of the season. Negative control (more specimens in treated than in untreated plots) is acknowledged by 0.0% to indicate lack of control.

*1.0 per cent level of significance.

**5.0 per cent level of significance.

***10.0 per cent level of significance.

1967, found malathion and methyl parathion sprays to be equally effective in killing weevil larvae.

A 20-acre field (No. 9) on the Widmyer Farm was sprayed with parathion (0.5 lb/A) and it was sampled at weekly intervals for three weeks. Adult weevil control was not satisfactory, but the populations were too low to make the readings meaningful. Larval reductions were satisfactory one, two, and three weeks post-treatment, but the populations were very low (Table 6-E).

An adjacent field (No. 7, Table 6-F) was sprayed twice with malathion (1.0 lb/A) and was sampled weekly for five weeks. In general, adult weevil control was excellent. Larval control was at the economic level one and two weeks post-treatment.

In this same field (No. 7, Table 6-G) one series of plots was sprayed a third time to compare two and three malathion sprays (1.0 lb/A) in over-all effectiveness in reducing current weevil populations. Adult weevil control was excellent in both series (two and three sprays). Larval reductions were slightly, but not significantly, greater in the plots receiving three sprays. At harvest time, about one week later, larval damage was much more evident in plots which had been sprayed only twice.

Methyl parathion spray was applied on one field on the Reedsville Farm and samples were taken weekly for three weeks. Adult weevils were

TABLE 7

COMPARATIVE EFFECTIVENESS OF HYDRAULIC SPRAY FOLIAR AND GRANULAR GROUND INSECTICIDE TREATMENTS APPLIED TO KILL THE ALFALFA WEEVIL (1967).

Adult Weevils			Weevil Larvae		
Treat-ments[a]	Comp. Effective-ness[b]	% Kill	Treat-ments[a]	Comp. Effective-ness[b]	% Kill
A—BLUE-HOCKENSMITH FARM (Plots 1/16A x 2) (NIA, 1st Trt. 4-21-67) (Coll. 4-28-67)					
8	a	0.0	2	a	93.0
7	a	0.0[c]	1	a	90.0
6	a	0.0[c]	4	a	68.0
5	a	0.0[c]	6	a	68.0
4	a	0.0[c]	7	a	50.0
3	a	0.0[c]	3	a	28.0
2	a	0.0[c]	8	a	0.0
1	a	0.0[c]	5	a	0.0[c]
(Coll. 5-3-67)					
8	a	0.0	1	a	96.0
7	a	0.0[c]	2	a	93.0
6	a	0.0[c]	3	ab	86.0
5	a	0.0[c]	6	bc	46.0
4	a	0.0[c]	7	bc	37.0
3	a	0.0[c]	8	bc	0.0
2	a	0.0[c]	4	c	0.0[c]
1	a	0.0[c]	5	c	0.0[c]**
(Coll. 5-10-67)					
8	a	0.0	3	a	99.0
7	a	0.0[c]	2	b	90.0
2	a	0.0[c]	1	b	89.0
4	a	0.0[c]	6	c	72.0
3	a	0.0[c]	7	d	50.0
5	ab	0.0[c]	5	de	35.0
6	ab	0.0[c]	4	de	14.0
1	b	0.0[c]**	8	e	0.0**

[a]Table 7-A Treatments: (Hydraulic sprayer, 90 psi, 20 G/A; granules applied with hand-type spreader)

1. NIA-10242, EC (0.25)
2. NIA-10242, EC (0.5)
3. NIA-10242, EC (1.0)
4. NIA-10242, Gr. 5.0% (1.0)
5. NIA-10242, Gr. 5.0% (2.0)
6. Chlordane, EC (1.0)
7. Galecron, EC (1.0)
8. Untreated (Geometric average adult weevil count 1.0; larval count 85.0)

B—BLUE-HOCKENSMITH FARM
(NIA, 2nd Trt. with treatments footnoted with[d].)

		(Coll. 5-16-67)			
3[d]	a	100.0	3[d]	a	96.0
5[d]	a	50.0	1[d]	ab	92.0
4	a	50.0	2	ab	91.0
2	a	50.0	6[d]	bc	41.0
7	a	50.0	7	bc	26.0
6[d]	a	50.0	5[d]	c	3.0
8	a	0.0	8	c	0.0
1[d]	a	0.0[c]	4	c	0.0[c]**
		(Coll. 5-24-67)			
7	a	100.0	2	a	92.0
4	a	100.0	3	a	91.0
2	a	100.0	4	ab	88.0
8	a	0.0	5	ab	77.0
3	a	0.0[c]	1	ab	62.0
1	a	0.0[c]	7	ab	53.0
5	a	0.0[c]	6	ab	25.0
6	a	0.0[c]	8	b	0.0**

[a]Table 7-B Treatments: (Hydraulic sprayer, 90 psi, 20 G/A; granules applied with hand-type spreader)

1. NIA-10242, EC (0.25)
2. NIA-10242, EC (0.5)
3. NIA-10242, EC (1.0)
4. NIA-10242, Gr. 5.0% (1.0)
5. NIA-10242, Gr. 5.0% (2.0)
6. Chlordane, EC (1.0)
7. Galecron, EC (1.0)
8. Untreated (Geometric average adult weevil count 1.0; larval count 85.0)

(Continued)

not numerous, but populations were reduced by the treatment for one and two weeks post-treatment. Larval control was excellent one, two, and three weeks post-treatment (Table 6-H).

The hard, cold, well water in the Eastern Panhandle part of the State at times has caused some precipitation problems in sprayers when emulsifiable formulations have been used. This was true in the case of azinphosmethyl. A 20-acre field on the Blue-Hockensmith Farm was sprayed with azinphosmethyl (1.5 lb. gallon formulation) to test its effectiveness in weevil control and performance in the sprayer using cold water. The adult weevil population was so low that sampling error made adult sampling data meaningless. Good to excellent larval reductions resulted from sprays at 0.5 and 0.75 lb/A rates and no clogging of sprayer nozzles was experienced (Table 6-I).

Five different treatments were applied on plots on the Blue Farm. Adult weevil samples were first taken two weeks post-treatment and at weekly intervals for four weeks. Larval samples were taken for five weeks post-treatment. Methyl parathion and malathion sprays gave perfect adult

TABLE 7 (Continued)

Adult Weevils			Weevil Larvae		
Treat-ments[a]	Comp. Effective-ness[b]	% Kill	Treat-ments[a]	Comp. Effective-ness[b]	% Kill
C—REEDSVILLE FARM (Small plots 1/16A x 2)					
(Coll. 5-5-67)					
9	a	85.0	6	a	91.0
13	ab	48.0	7	ab	82.0
16	ab	0.0	4	abc	69.0
3	ab	0.0[c]	12	abc	64.0
6	ab	0.0[c]	1	abc	56.0
5	ab	0.0[c]	5	abc	53.0
11	ab	0.0[c]	13	abc	51.0
4	ab	0.0[c]	8	abc	37.0
7	ab	0.0[c]	10	abc	35.0
12	ab	0.0[c]	11	abc	22.0
10	ab	0.0[c]	16	abc	0.0
2	ab	0.0[c]	3	abc	0.0[c]
15	ab	0.0[c]	2	abc	0.0[c]
1	b	0.0[c]	9	bc	0.0[c]
14	b	0.0[c]	15	bc	0.0[c]
8	b	0.0[c]**	14	c	0.0[c]**
(Coll. 5-12-67)					
13	a	80.0	7	a	99.0
3	a	80.0	6	a	98.0
2	a	80.0	4	b	93.0
12	ab	71.0	12	b	93.0
4	ab	71.0	10	bc	86.0
6	ab	71.0	13	bcd	82.0
5	ab	60.0	5	bcde	82.0
9	ab	46.0	2	cde	70.0
16	ab	0.0	11	def	66.0
14	ab	0.0[c]	1	def	59.0
10	ab	0.0[c]	9	def	54.0
11	ab	0.0[c]	8	def	54.0
1	ab	0.0[c]	3	def	42.0
15	ab	0.0[c]	15	ef	28.0
8	ab	0.0[c]	14	f	10.0
7	b	0.0[c]***	16	f	0.0**

(*Coll. 5-18-67*)

3	a	51.0	6	a	99.0
9	ab	39.0	7	ab	97.0
2	ab	33.0	12	abc	94.0
16	ab	0.0	13	cd	87.0
14	ab	0.0[c]	10	cd	83.0
13	ab	0.0[c]	4	cd	83.0
8	ab	0.0[c]	5	cd	83.0
11	ab	0.0[c]	3	cd	81.0
4	ab	0.0[c]	2	cd	80.0
5	ab	0.0[c]	11	cde	74.0
6	ab	0.0[c]	1	cde	74.0
12	ab	0.0[c]	15	de	73.0
15	ab	0.0[c]	9	de	64.0
10	ab	0.0[c]	8	de	64.0
1	ab	0.0[c]	14	de	48.0
7	b	0.0[c]	16	e	0.0**

[a]Table 7-C Treatments: (Hydraulic sprayer, 30 psi, 15 G/A; granules applied with hand propelled spreader; all treatments applied 4-28-67)

1. Baygon, Gr. (2.0)
2. Phorate, Gr. (1.0)
3. Am. Cyan. 47031, EC (1.0)
4. Am. Cyan. 47470, EC (1.0)
5. NIA-10242, 5.0% Gr. (1.0)
6. NIA-10242, 50WP (1.0)
7. NIA-10242, 50WP (0.5)
8. Baygon, EC (4 oz) + azinphos-methyl, EC (4 oz)
9. Baytex, EC (4 oz) + azinphos-methyl, EC (4 oz)
10. Baytex, EC (0.5)
11. Am. Cyan. 47031, EC (0.5)
12. Phorate, EC (1.0)
13. Phorate, EC (1.0)
14. Baygon, Gr. (1.0)
15. NIA-10242, Gr. (0.5)
16. Untreated (Geometric average adult weevil count 5.0; larval count 808.0)

[b]Duncan's Multiple Range Test at level indicated for Log (N + 1) of the data; antilog of data means —1 is presented as the geometric average count for 25 sweeps. Treatments sharing a letter in common do not differ in effectiveness.

[c]The aberrant data concerning adult weevil counts is mainly because of the scarcity of weevils at this time of the season. Negative control (more specimens in treated than in untreated plots) is acknowledged by 0.0% to indicate lack of control.

[d]Treated second time 5-10-67.

**5.0 per cent level of significance.

***10.0 per cent level of significance.

weevil control for two, three, and four weeks post-treatment. All treatments produced economic larval control one week post-treatment; malathion and methyl parathion, three weeks post-treatment; and only methyl parathion spray four weeks post-treatment (Table 6-J). Bass and Blake (1964) also found methyl parathion to be more toxic than parathion to weevil larvae.

Carbaryl WP was applied on a field April 26, 1967, on the Reedsville Farm, but economic control was not achieved for adult or larval stages of the weevil one or two weeks post-treatment (Table 6-K). A malathion spray was applied May 18, 1967, in order to save the crop.

TABLE 8

COMPARATIVE EFFECTIVENESS OF GAS FLAMING FOLLOWED BY FOLIAR SPRAY TREATMENTS TO CONTROL THE ALFALFA WEEVIL (1967).

ADULT WEEVILS			WEEVIL LARVAE		
TREAT-MENTS[a]	COMP. EFFECTIVE-NESS[b]	% KILL	TREAT-MENTS[a]	COMP. EFFECTIVE-NESS[b]	% KILL
A—PRESTON DAVIS FARM (Plots 2A x 2)					
(Coll. 5-12-67)					
3	a	98.0	1	a	96.0
1	ab	92.0	2	ab	96.0
2	bc	85.0	4	ab	89.0
6	bc	65.0	3	ab	71.0
4	bc	58.0	5	ab	0.0
5	c	0.0**	6	b	0.0[c]***
(Coll. 5-23-67)					
2	a	97.0	3	a	87.0
3	b	76.0	2	ab	80.0
1	bc	18.0	4	ab	79.0
5	c	0.0	1	ab	72.0
6	c	0.0[c]	5	ab	0.0
4	c	0.0[c]**	6	b	0.0[c]**

[a]Table 8-A Treatments: (Hydraulic sprayer, 30 psi, 25 G/A; applied 5-3-67; entire field LP gas flamed 3-31-67, 60 psi, 3.5 mph)

1. Malathion, EC (1.25)
2. Azinphosmethyl, EC (0.75)
3. Malathion, EC (1.0)
4. Carbaryl, 80WP (1.0)
5. Untreated (Geometric average adult weevil count 28.0; larval count 81.0)
6. Naled, EC (1.0)

B—REEDSVILLE FARM					
(Area 4, Sections 1, 2, 3; plots 5A x 2)					
(Coll. 5-5-67)					
1	a	75.0	2	a	88.0
2	a	0.0	1	b	0.0**
(Coll. 5-12-67)					
2	a	85.0	2	a	97.0
1	b	0.0**	1	b	0.0*

[a]Table 8-B Treatments: (Hydraulic sprayer, 30 psi, 15 G/A; applied as indicated)

1. LP gas flamed, 60 psi, 3.5 mph; 4-27-67; sprayed malathion, EC (1.0), 5-2-67
2. Untreated (Geometric average adult weevil count 37.0; larval count 1147.0)

C—REEDSVILLE FARM (A6, S1: plots 6.5A x 2)					
(Coll. 5-5-67)					
2	a	80.0	2	a	89.0**
1	a	. . .	1	b	

		(Coll. 5-12-67)			
2	a	92.0**	2	a	86.0***
1	b		1	b	

[a]Table 8-C Treatments: (Hydraulic sprayer, 30 psi, 15 G/A; applied as indicated)
1. LP gas flamed, 60 psi, 3.5 mph; 3-20-67
2. LP gas flamed, 60 psi, 3.5 mph; sprayed malathion, EC (1.0), 5-2-67

(No untreated plots, the per cent represents per cent fewer specimens in one treated area as compared with the other; geometric average adult weevil count 28.0; larval count 374.0)

D—REEDSVILLE FARM (A5, S1; plots 6.5A x 2)

		(Coll. 5-5-67)			
2	a	0.0[c]	2	a	62.0
3	a	0.0	3	a	0.0
1	a	0.0[c]	1	a	0.0[c]
		(Coll. 5-12-67)			
2	a	100.0	2	a	83.0
1	ab	80.0	1	b	7.0
3	b	0.0***	3	b	0.0**

[a]Table 8-D Treatments: (LP gas flamed 60 psi, 3.5 mph; hydraulic sprayer, 30 psi, 15 G/A)
1. Flamed, 3-20-67
2. Flamed, 3-20-67; sprayed, malathion, EC (1.0), 5-2-67
3. Untreated (Geometric average adult weevil count 4.0; larval count 428.0)

E—REEDSVILLE FARM (A5, S1) (Plots 2A x 2)

		(Coll. 5-5-67)			
2	a	0.0[c]	2	a	83.0
1	a	0.0[c]	1	b	7.0
3	a	0.0	3	b	0.0*
		(Coll. 5-12-67)			
2	a	100.0	2	a	62.0
1	ab	80.0	3	a	0.0
3	b	0.0***	1	a	0.0[c]

[a]Table 8-E Treatments: (LP gas flamed, 60 psi, 3.5 mph, 3-20-67; hydraulic sprayer, 30 psi, 15 G/A)
1. Flamed only, 3-20-67
2. Flamed 3-20-67 and sprayed, malathion, EC (1.0), 5-2-67
3. Untreated (Geometric average adult weevil count 3.0; larval count 334.0)

[b]Duncan's Multiple Range Test at level indicated for Log $(N + 1)$ of the data; antilog of data means -1 is presented as the geometric average count for 25 sweeps. Treatments sharing a letter in common do not differ in effectiveness.

[c]The aberrant data concerning adult weevil counts is mainly because of the scarcity of weevils at this time of the season. Negative control (more specimens in treated than in untreated plots) is acknowledged by 0.0% to indicate lack of control.

*1.0 per cent level of significance.

**5.0 per cent level of significance.

***10.0 per cent level of significance.

Small plots on the Blue-Hockensmith Farm were treated with granular NIA-10242 and NIA-10242 sprays and with chlordane and Galecron sprays. Extremely low adult weevil populations at the time of sampling rendered sampling data practically meaningless. Economic larval control was evident in plots treated with NIA-10242 spray (0.5 lb/A and 0.25 lb/A) three weeks post-treatment and at the 1.0 lb/A rates two and three weeks post-treatment (Table 7-A). Some of the plots were treated the second time on May 10 and weevil control results in these plots were compared with those in plots which were sprayed only one time on April 21. The plot sprayed the second time with NIA-10242 (1.0 lb/A) was the only treatment which produced satisfactory adult weevil reduction one week post-treatment. Galecron spray, NIA-10242 granules (1.0) and spray at 0.5 lb/A all gave excellent control of the scarce adults four weeks post-treatment. The only economic larval treatments, two weeks post-treatment, were observed in plots treated with NIA-10242 sprays (1.0 and 0.5 lb/A) and granules (1.0 lb/A) (Table 7-B). The best larval control one week post-treatment appeared in the plots treated twice with NIA-10242 sprays at 0.25 and 1.0 lb/A rates.

Small plots on the Reedsville Farm were treated with 15 kinds of insecticidal spray and granular formulations. Population samples were taken weekly for three weeks after treatment. The only treatment which gave economic adult weevil control one week post-treatment was Baytex plus azinphosmethyl spray; the only treatments which gave economic control of adults two weeks post-treatment were phorate and Amer. Cyan. 47031 sprays and phorate granules. NIA-10242 sprays (1.0 and 0.5 lb/A) produced economic larval control one week post-treatment. Nine treatments gave economic control three weeks post-treatment, they were: NIA-10242-sprays (1.0 and 0.5 lb/A), granules (1.0 lb/A); phorate granules (2.0 and 1.0 lb/A), sprays (1.0 lb/A); Baytex spray (1.0 lb/A); Amer. Cyan. 47470 spray (1.0 lb/A) and Amer. Cyan. 47031 spray (1.0 lb/A) (Table 7-C).

Table 8 summarizes the effectiveness in larger field plots of hydraulic spray treatments which were preceded by gas flaming earlier in the season. Malathion (1.25 lb/A) and azinphosmethyl (0.75 lb/A) sprays were the most effective treatments on the Preston Davis farm (Table 8-A). Alfalfa weevil control was better in fields on the Reedsville Farm, which were flamed in March or early April; this kind of treatment was followed by a foliar spray application of malathion (1.0 lb/A) applied in early May (Table 8-B, 8-C).

Summary and Conclusions

Integrated control efforts, planned and directed against the many life stages of the alfalfa weevil, are necessary for a meaningful control

program. Choice of the right insecticides, correct rate, proper method, and timing of applications are most important considerations.

An efficient control program is based on field treatments during the dormant or semi-dormant alfalfa season to kill ovipositing weevils and eggs either in late October or mid-November or mid-March to mid-April (depending upon the weather). Ninety to 95 per cent of the fall-laid eggs have hatched in most of the areas of West Virginia by mid-to-late March. These treatments should be followed with one or two foliar sprays (to kill feeding larvae) applied in the spring. The first application is usually made from mid-to-late April and the second should be applied two to three weeks after the first; this will depend upon the prevailing weather, the nature of weevil populations, and the kind of insecticide used.

If only foliar sprays are applied in the spring, at least two properly timed ones are necessary in this region to achieve economic control. Steinhauer and Blickenstaff (1966) were also of the opinion that more than one foliar spray is necessary to accomplish satisfactory weevil control.

If phorate granules are used in the spring in this region they must be applied (at least 2.0 lb/A) from mid-March to the first part of April if the treatment is to be effective against larvae and emerging adults. The granular treatment should also be followed by one or two foliar spray treatments (malathion (1.0 lb/A); methyl parathion (0.5 lb/A) or azinphosmethyl (1 trt., 0.75 lb/A).

The experimental results obtained from certain hydrocarbons (Sun Oil 91EL and 11EL) used alone and hydrocarbon-insecticide mixtures applied as sprays merit further investigations. The control of adults and larvae was at an economic level in both types of treatments and in the case of the insecticide combination, the dosage rate of the insecticide (malathion) was reduced to one-half the usual rate. The hydrocarbons were particularly effective against the adult stages of weevils and caused no phytotoxicity at the rates used (4 G/A). Sun Cote wax when used as a mixture with malathion spray or applied alone after the malathion spray, apparently was more effective in reducing weevil populations than the malathion spray alone.

The most effective candidate insecticidal sprays against weevil larvae at the rates used in the experiments reported on were: Furadan (NIA-10242), Imidan, and Amer. Cyan. 47470. Phorate was the most effective granular formulation of any of the insecticides when applied in the very early spring at the rate of at least 2 lbs/A.

Malathion EC (1.0 lb/A), azinphosmethyl EC (0.75 lb/A), and methyl parathion EC (0.5 lb/A) sprays when properly applied are effective treatments against the alfalfa weevil.

The alfalfa weevil can be controlled at an economic level (80 per cent or more population reduction) and hay yields increased if correct procedures are followed.

REFERENCES CITED

Bass, H. and G. H. Blake, Jr. 1964. Susceptibility of fourth instar alfalfa weevil larvae to forty-one insecticides. J. Econ. Entomol. 57(5):665-66.

Bennett, S. E. and C. A. Thomas. 1963. The correlation between lipid content and per cent mortality of the alfalfa weevil to heptachlor and malathion. J. Econ. Entomol. 56(2):239-40.

Dorsey, C. K. 1966. Spring and fall applications of insecticides for alfalfa weevil control, 1963-64. J. Econ. Entomol. 59(3):735-38.

Harrendorf, Keith, Armon J. Keaster, and Flernoy G. Jones. 1967. Relative toxicity of five insecticides to alfalfa weevil larvae. J. Econ. Entomol. 60(4):1115-16.

Pfadt, Robert E. 1964. Alfalfa weevil control by stubble treatment. J. Econ. Entomol. 57(6):996-97.

Steinhauer, A. L. and C. C. Blickenstaff. 1962. Experiments on alfalfa insect control in Maryland. J. Econ. Entomol. 55(5):718-22.

Wilson, M. C. 1966. Evaluating insecticides for alfalfa weevil control. Indiana Agr. Exp. Sta. Res. Prog. Rep. Sept. 226-227.